Assignment

B.Sc. Chem(Hons) Ist year

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Thermochemistry

1. The formation of SO_3 from SO_2 and oxygen,
   $SO_2\,(g) + \frac{1}{2}\,O_2\,(g) \rightarrow SO_3\,(g)$
   is exothermic by 97030 J at 298 K and 1atm measured in a bomb calorimeter. What is the value of ΔH?

2. Compute the standard heat of formation of methane using the following data:
   i. $CH_4\,(g) + 2\,O_2\,(g) \rightarrow CO_2\,(g) + 2\,H_2O\,(l)$, $\Delta H°(298K)$= -890.35 KJ
   ii. $H_2\,(g) + \frac{1}{2}\,O_2\,(g) \rightarrow H_2O\,(l)$, $\Delta H°(298K)$= -285.84 KJ
   iii. C(graphite) + $O_2\,(g) \rightarrow CO_2\,(g)$,), $\Delta H°(298K)$= -393.51 KJ

3. For a reaction $CO\,(g) + H_2O\,(g) \rightarrow CO_2\,(g) + H_2\,(g)$,$\Delta H°(298K)$= -42.0 KJ. The heat capacities of various species are given by
   $C_{P,m}\,(CO)/JK^{-1}mol^{-1} = 26.8 + 7.0 \times 10^{-3}\,T$
   $C_{P,m}\,(H_2O, g)/JK^{-1}mol^{-1} = 30.4 + 9.6 \times 10^{-3}\,T$
   $C_{P,m}\,(CO_2)/JK^{-1}mol^{-1} = 26.0 - 43.5 \times 10^{-3}\,T$
   $C_{P,m}\,(H_2)/JK^{-1}mol^{-1} = 29.0 - 0.80 \times 10^{-3}\,T$
   Calculate (a) $\Delta H°(1298K)$, (b) $\Delta U°(1298K)$

4. Using the bond energy data , compute $\Delta H°$ of formation for ethyl alcohol (C_2H_5OH). $DH°\,(C-H) = 413\,kJ$, $DH°\,(C-C) = 348\,kJ$, $DH°\,(C-O) = 351\,kJ$, $DH°\,(O-H) = 463\,kJ$.

5. It is estimated that an average human brain consumes the equivalents of 10g glucose per hr. Estimate the power output of the brain in watts.
   Given that 1W = $1Js^{-1}$;
   $\Delta H°f$(H_2O, l) = - 286 kJ/mol
   $\Delta H°f$(CO_2, g) = - 394 kJ/mol
   $\Delta H°f$(glucose, aq) = - 1260 kJ/mol.

6. Calculate the enthalpy change for the process
   H_2O (l, -10°C) → H_2O (s, -10°C)
   given that:
   $C_{P,m}$ (H_2O, l) = 75.4 $JK^{-1}mol^{-1}$
   $C_{P,m}$ (H_2O, s) = 37.2 $JK^{-1}mol^{-1}$
   H_2O (l, 0°C) → H_2O (s, 0°C), $\Delta H = -6008\, J/mol$.

7. The heat of dissociation per mole of gaseous water at 18°C and 1 *atm* is 241750 *J*; calculate its value at 68° C. Data given are
   C_P (H_2O) = 33.56; C_P (H_2) = 28.83; C_P (O_2) = 29.12 $JK^{-1}mol^{-1}$